life data. In addition, they consent to broad randomization for being offered experimental interventions.
Within this cohort, patients eligible for boost treatment - LARC (T3+/4NxM0 or TxN2M0) located ≤10cm from the anus - are included in a sub-cohort. From this sub-cohort, a random sample is offered the boost treatment in addition to CRT (intervention arm); this offer may be accepted or refused. Patients who are not randomly selected to be offered the boost intervention undergo standard CRT without further study notification (control arm). Data will be analyzed according to intention-to-treat.
The boost intervention consists of 5 x 3Gy to the gross tumor volume (without concomitant chemotherapy) delivered 1 week prior to standard CRT (25 x 2Gy combined with capecitabine).
Results: In the past 6 weeks, of the 10 eligible patients, 9 consented for cohort participation and gave broad consent for randomization. All nine patients were randomized. Four patients were allocated to the control arm and received CRT without further notification. Five patients were allocated to the intervention arm and were offered the boost in addition to CRT. Three patients accepted and underwent the boost, whereas 2 refused because of personal reasons and reluctance to undergo MRI.
Conclusions: The cmRCT design shows potential to achieve high recruitment rates (9 out of 10 patients) and offer patients interventions by asking broad consent for randomization. If the number of patients refusing the offer remains high, the boost effect may be diluted, demanding advanced statistical solutions (instrumental variable analysis). Updated results will be presented in April 2015.

Poster: Physics track: Basic dosimetry and phantom detector developments/characterisation

PO-0814

A new approach to convert high energy imaging systems (EPID)signal into absorbed dose to water

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Purpose/Objective: During the past 10 years, the mathematical models proposed for converting an EPID signal into absorbed dose to water have evolved considerably by integrating correction functions of various degrees of complexity to take modern conditions of irradiation into account. As a whole, these models require prior knowledge of mechanical and dosimetric data for the radiation beams so that suitable correction factors can be applied. However, in spite of all this sophistication, the results obtained show discrepancies between the calculated and measured doses that may exceed 5% for image pixels that have received an equivalent dose lower than 30cGy in water.
In this work, we propose a new method for calibrating the EPID detector which leads to a simple, robust model of the detector response to irradiation by X-ray photons, in absorbed dose to water. This modelling applies to all pixels of the image, without any correcting factor and whatever the level of the equivalent dose in water.
Materials and Methods: Starting from the hypothesis that the grey level (GL) read in each pixel of the image is proportional to the average dose in water (D) delivered by the irradiating beam for each acquisition frame making up the final image (D=Dtot/Nbframes; Dtot: total dose delivered by the beam; Nbframes: number of acquisition frames), we established a simple relation among all these data:
$D = A + B * \ln(GL - C)$ Equation1
The coefficients A, B and C are obtained by mathematical modelling of the pairs of values of D and GL read on the central pixel of a set of images called 'calibration images'.
Results: Applied to each of the 37 'calibration images', Equation 1 showed differences of less than 2% between the calculated dose and the dose measured in water for the central pixel. When this equation was applied, with no additional mathematical correction, to all the pixels of the 2-D image, the results showed that over 95% of the points of the image respected a γ-index criterion fixed at 2%/2mm. This modelling was also applied to 2-D EPID images obtained by simulating VMAT fields and the results satisfied a γ-index criterion fixed at 3%/3mm for more than 95% of the points analysed.
Conclusions: Our method allows the EPID to be considered and used as a 2-D detector measuring the absolute absorbed dose to water.

PO-0815

Dosimetric precision of 3D gel dosimetry compared with radiochromic films in volumetric modulated arc therapy

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Purpose/Objective: The complexity of modern radiotherapy necessitates comprehensive dose validation which has motivated research into three dimensional (3D) dosimetry. One such dosimetry system is based on polymerization of monomers suspended in a gelatin matrix. To verify the performance of such a polymer gel dosimetry system we have in this study compared its dosimetric precision to that of conventional radiochromic films.
Materials and Methods: A cylindrical normoxic polyacrylamide gel (nPAG) dosimeter (Ø15cm x 15cm) and an EBT2 radiochromic film dosimeter (15x15cm^2) were irradiated with a volumetric modulated arc therapy (VMAT) plan. During irradiation the film was embedded in the gel dosimeter to obtain similar irradiation conditions. The resulting dose distribution consisted of a cylindrical shaped dose region with a gradient along the cylinder axis from 5 Gy to 0 Gy. The dose distributions were subsequently read out using an optical CT scanner and a flatbed scanner, respectively, and were then compared to the calculated distribution using a voxel-to-voxel difference analysis.
Results: Good agreement was observed between the two measurements and the calculated plan as seen in figure 1. A slight deviation of the gel measurement was observed at the lowest dose. The voxel-to-voxel difference analysis resulted

in a standard deviation, i.e. dosimetric precision, of 0.14 Gy between the gel and film measurement while differences of 0.11 Gy for the gel and 0.13 Gy for the film was found when comparing to the calculated dose distribution.

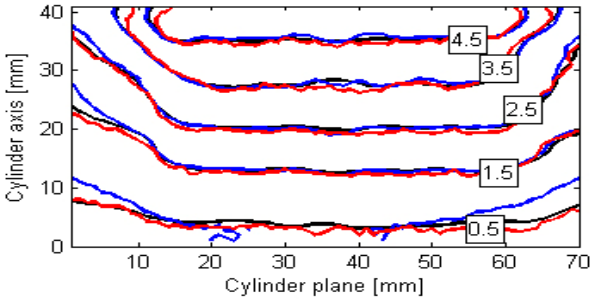

Figure 1: Contour plot of the gradient section of the calculated dose distribution (black), the gel measurement (blue) and the film measurement (red). The dose values are shown in units of Gray.

Conclusions: Both gel and film reproduced the delivered dose distribution with only small deviations. In addition, the gel measurement showed slightly higher dosimetric precision than the film when compared to the calculated distribution. This study therefore shows that this 3D dosimetry system can provide dosimetric precision that is comparable with radiochromic film dosimetry.

PO-0816

Feasibility of luminescence screen based quality assurance system for verification of SRS beams

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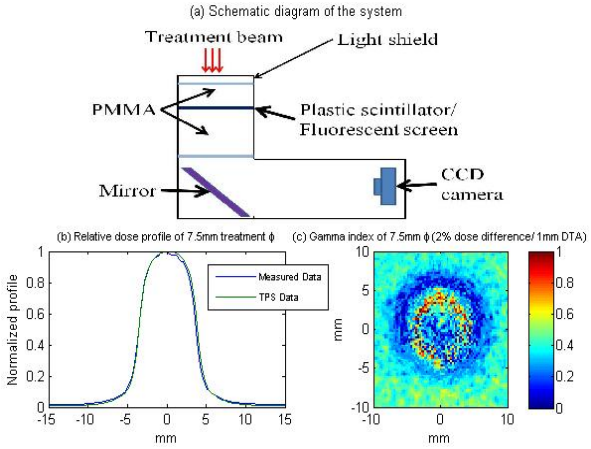
Purpose/Objective: To evaluate and characterize a luminescence screen based QA system as implemented in SRS treatment field verification of a linac system.

Materials and Methods: The home-made QA system consists of a set of PMMA block, a luminescence screen (interchangeable between plastic scintillator and fluorescent screen), a CCD camera and a light-tight box. The characteristics of fluorescent screen (Kodak, Lanex regular screen) and plastic scintillator (Apex, Anthracene with base polyvinyltoluene) were quantified on a linac (VARIAN TrueBeam). The PMMA block has a size of 30cm x 30cm and different build up thickness can be used depending on beam energy and the depth of beam profile to be evaluated. 10 cm thick PMMA was put behind the screen to ensure enough backscatter radiation. The signal light was reflected by a mirror below the transparent PMMA to a CCD camera away from the PMMA block. Dose linearity was examined on both materials by applying a range of MU from 1 to 300 under a 10cm X 10cm radiation field. After applying a median-filter to remove radiation induced noise from the captured image, the mean signal of a small ROI (10 cm^2) at the centre were calculated and correlated with the corresponding doses. The system can then be calibrated. Dose rate dependence was tested by varying dose rate from 200 MU/Min to 600 MU/Min. Energy dependence was also investigated with different radiation energies including 6MV and 15MV photon beams and 6MeV, 9MeV, 12MeV, 16MeV, 20MeV electron beams. Parasitic Cherenkov emission signals were eliminated by applying a deconvolution kernel on the original signals. Small circular field size measurements, from 7.5mm to 30 mm in diameter, were done at the appropriate depth. Both inline and crossline absolute radiation profiles of the circular fields were then obtained.

Results: The pixel values increase linearly with the delivered dose up to 3Gy and a linear regression analysis yields R^2 > 0.99. In this system, the minimum detectable dose is 12 mGy for plastic scintillator and 2 mGy for fluorescent screen on 6MV beam. In dose rate dependence test, plastic scintillator has a maximum deviation of 1.3% from 200MU/Min to 600 MU/Min on 6 MV while fluorescent screen has a maximum deviation of 1.1%. Plastic scintillator shows a maximum deviation of 4.2% for photon beam energy up to 15MV and electron beam energy up to 20MeV. Fluorescent screen shows clear energy dependence. The pixel size of the system is about 0.26 mm. In small circular field sizes measurement, measured dose distributions agree with the data generated by TPS. The gamma index passing rate for 7.5mm and 30 mm diameter collimator is 98.8% (2% dose difference /1 mm DTA) and 99.0 % (2% dose difference /1 mm DTA) respectively.



Conclusions: The luminescence screen based quality assurance system we developed has excellent dose linearity and dose rate independence. The system can provide fast and precise absolute dose verification of a treatment beam after calibration. The high precision characteristic of the system makes it valuable for dose verification of small treatment beams.

PO-0817

Clinical evaluation of intrafraction motion in mask system for Gamma Knife measured with IR tracking and cone-beam CT

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